

WHAT IS CLAIMED IS:

[c01] 1. A material comprising:

a plurality of structural components, said components configured in a series of increasing structural component size classes, said series having a base unit size class and at least one modular size class, wherein a component of said at least one modular size class comprises a plurality of components of the next smaller size class in said series;

 wherein said structural components of said base unit size class comprise at least one bulk phase;

 wherein said structural components are bonded together at interfaces;
and

 wherein mechanical damage originating within a modular size class structural component is energetically favored to propagate in a distributed fashion among said plurality of structural components contained within said modular size class structural component.

[c02] 2. The material of claim 1, wherein a toughness of said interfaces bonding together modular size class structural components is greater than a toughness of said interfaces bonding together said plurality of structural components contained within said modular size class structural components,

 and wherein said toughness of said interfaces bonding said modular size class structural components together is less than a toughness of said at least one bulk phase.

[c03] 3. The material of claim 1, wherein said interfaces are selected from the group consisting of mechanically interlocked interfaces, chemically bonded interfaces, and combinations thereof.

[c04] 4. The material of claim 3, wherein said interfaces bond said structural components in more than one dimension.

[c05] 5. The material of claim 4, wherein said interfaces bond said structural components in three dimensions.

[c06] 6. The material of claim 3, wherein said interfaces comprise chemically bonded interfaces, and wherein said interfaces comprise at least one interfacial phase.

[c07] 7. The material of claim 6, wherein said interfaces bonding structural components of a first size class comprise a different material than interfaces bonding structural components of a second size class.

[c08] 8. The material of claim 7, wherein each size class of structural components in said series is bonded together by interfaces comprising a material unique to said interfaces bonding said size class.

[c09] 9. The material of claim 6, wherein said interfacial phase comprises a material selected from the group consisting of a ceramic, a glass-ceramic, carbon, and mixtures thereof.

[c10] 10. The material of claim 9, wherein said interfacial phase comprises at least one of hexagonal boron nitride, lanthanum phosphate, aluminum oxide (alumina), titanium silicon carbide (Ti_3SiC_2), silica, zirconia, and mixtures and compounds of any of the foregoing materials.

[c11] 11. The material of claim 3, wherein said chemically bonded interfaces comprise sintered material.

[c12] 12. The material of claim 1, wherein said at least one bulk phase comprises at least one of a ceramic, an organic material, and a metal.

[c13] 13. The material of claim 12, wherein said ceramic comprises at least one of a nitride, an oxide, a carbide, a silicide, a silicate, and mixtures thereof.

[c14] 14. The material of claim 13, wherein said ceramic comprises silicon carbide, titanium carbide, zirconium carbide, hafnium carbide, molybdenum carbide, tantalum carbide, silicon nitride, silicon aluminum oxynitride, aluminum nitride, titanium nitride, titanium diboride, molybdenum disilicide, aluminum oxide, and aluminum silicate.

[c15] 15. The material of claim 1, wherein substantially all of said structural components have a substantially similar shape.

[c16] 16. The material of claim 15, wherein said shape is characterized by a cross sectional geometry, and wherein said geometry is one of rectangular and circular.

[c17] 17. The material of claim 1, wherein said interfaces of said structural components comprise material having a predetermined porosity level.

[c18] 18. The material of claim 17, wherein said porosity level varies as a function of said component size class.

[c19] 19. A material comprising:

a plurality of structural components, said components configured in a series of increasing structural component size classes, said series having a base unit size class and at least one modular size class, wherein a component of said at least one modular size class comprises a plurality of components of the next smaller size class in said series;

wherein said structural components of said base unit size class comprise at least one bulk phase comprising at least one of a nitride, an oxide, a carbide, a silicide, a silicate, and mixtures thereof;

wherein said structural components are bonded together at chemically bonded interfaces comprising at least one interfacial phase, said interfacial phase comprising a ceramic, a glass-ceramic, carbon, and mixtures thereof;

wherein a toughness of said interfaces bonding modular size class structural components of a first size class together is greater than a toughness of said interfaces bonding together said plurality of structural components contained within said structural components of said first size class,

and wherein said toughness of said interfaces bonding modular size class structural components of said first size class together is less than a toughness of said at least one bulk phase.

[c20] 20. An article comprising:

a material comprising a plurality of structural components, said components configured in a series of increasing structural component size classes, said series having a base unit size class and at least one modular size class, wherein a component of said at least one modular size class comprises a plurality of components of the next smaller size class in said series;

wherein said structural components of said base unit size class comprise at least one bulk phase;

wherein said structural components are bonded together at interlocking interfaces; and

wherein mechanical damage originating within a modular size class structural component is energetically favored to propagate in a distributed fashion

among said plurality of structural components contained within said modular size class structural component.

[c21] 21. The article of claim 20, wherein a toughness of said interfaces bonding modular size class structural components of a first size class together is greater than a toughness of said interfaces bonding together said plurality of structural components contained within said structural components of said first size class,

and wherein said toughness of said interfaces bonding modular size class structural components of said first size class together is less than a toughness of said at least one bulk phase.

[c22] 22. The article of claim 21, wherein said interfaces comprise chemically bonded interfaces, and wherein said interfaces comprise at least one interfacial phase.

[c23] 23. The article of claim 22, wherein said interfacial phase comprises a material selected from the group consisting of a ceramic, a glass-ceramic, carbon, and mixtures thereof.

[c24] 24. The article of claim 20, wherein said at least one bulk phase comprises at least one of a nitride, an oxide, a carbide, a silicide, a silicate, and mixtures and compounds thereof.

[c25] 25. The article of claim 20, wherein said article comprises a component of a gas turbine assembly.

[c26] 26. An article comprising:

a material comprising

a plurality of structural components, said components configured in a series of increasing structural component size classes, said series having a base unit size class and at least one modular size class, wherein a component of said at least one

modular size class comprises a plurality of components of the next smaller size class in said series;

wherein said structural components of said base unit size class comprise at least one bulk phase comprising at least one of a nitride, an oxide, a carbide, a silicide, a silicate, and mixtures and compounds thereof;

wherein said structural components are bonded together at chemically bonded interfaces comprising at least one interfacial phase, said interfacial phase comprising a ceramic, a glass-ceramic, carbon, and mixtures thereof;

wherein a toughness of said interfaces bonding modular size class structural components of a first size class together is greater than a toughness of said interfaces bonding together said plurality of structural components contained within said structural components of said first size class,

and wherein said toughness of said interfaces bonding modular size class structural components of said first size class together is less than a toughness of said at least one bulk phase.